

Claims

- [c1] 1. A metal casting core assembly for casting a crankshaft having a central axis, comprising a plurality of foundry sand cores each having an interior opening for receiving molten metal to each form a different portion of the crankshaft, the sand cores each being aligned along the central axis of the crankshaft and having plurality of core bolt holes that are aligned as the core assembly is assembled and each of which receive a core bolt that extends parallel to the axis, the core bolts each being secured with a retaining nut to hold the core assembly together with compressive loading.
- [c2] 2. The metal casting core assembly of claim 1 further comprising a plurality of oil gallery cores that are received in the sand cores, the oil gallery cores extending through one of the interior openings to define an oil gallery in the crankshaft.
- [c3] 3. The metal casting core assembly of claim 2 wherein the oil gallery cores are formed of high temperature resin bonded sand.
- [c4] 4. The metal casting core assembly of claim 2 wherein

the oil gallery cores have at least one elongated body portion and an anchoring portion on each end of each body portion, the anchoring portions each being received in a cut-out formed in one of the sand cores, the cut-out being shaped to correspond to one of the anchoring portions.

- [c5] 5. The metal casting core assembly of claim 4 wherein the anchors are tapered to form a narrower side that is received in the base of the cut-out and a wider side at a mating surface of the sand core in which the anchoring portion is received.
- [c6] 6. The metal casting core assembly of claim 1 wherein the sand cores each have at least one mating surface that is placed face-to-face with a mating surface of an adjacent sand core.
- [c7] 7. The metal casting core assembly of claim 6 wherein a first set of the mating surfaces have locator pins and a second set of the mating surfaces have locator pin recesses, and wherein one adjacent sand core has locator pins and one adjacent sand core has locator pin recesses that are positioned to receive the locator pins.
- [c8] 8. The metal casting core assembly of claim 1 further comprising at least one insert made of a metal composi-

tion that is different than the molten metal used to form the crankshaft.

- [c9] 9. The metal casting core assembly of claim 8 further comprising at least one sand positioning member secured to one of the sand cores and to the insert to retain the insert in one of the interior openings.
- [c10] 10. The metal casting core assembly of claim 1 further comprising:
 - a first one of the sand cores having the interior opening defining a post end of the crankshaft, a first main bearing, and a part of a first counter-weight;
 - a second one of the sand cores has two sides and having the interior opening on a first side defining a first connecting rod pin and a part of a first counter-weight and on a second side a part of the second counter-weight;
 - a third one of the sand cores has two sides and having the interior opening defining on a first side a fourth connecting rod pin and a part of the second counter-weight and on a second side part of a third counter-weight;
 - a fourth one of the sand cores has two sides and having the interior opening defining on a first side a second main bearing journal and a part of the third counter-weight and on a second side part of a fourth counter-weight;
 - a fifth one of the sand cores has two sides and having

the interior opening defining on a first side a second connecting rod pin and a part of the fourth counter-weight and on a second side part of a fifth counter-weight;

a sixth one of the sand cores has two sides and having the interior opening defining on a first side a fifth connecting rod pin and a part of the fifth counter-weight and on a second side part of a sixth counter-weight; a seventh one of the sand cores has two sides and having the interior opening defining on a first side a third main bearing journal and a part of the sixth counter-weight and on a second side part of a seventh counter-weight;

an eighth one of the sand cores has two sides and having the interior opening defining on a first side a third connection rod pin and a part of the seventh counter-weight and on a second side part of an eighth counter-weight;

a ninth one of the sand cores has two sides and having the interior opening defining on a first side a sixth connecting rod pin and a part of the eighth counter-weight and on a second side part of a ninth counter-weight, and further comprising a connecting rod pin lightener sand core being secured to the first side of the ninth core in the interior opening;

a tenth one of the sand cores has two sides and having

the interior opening defining on a first side a main bearing journal and a part of the ninth counter-weight and on a second side a part of a flywheel hub; and an eleventh one of the sand cores has the interior opening defining a part of a flywheel hub and a metal in-gate ported to the interior opening and further comprising a flywheel hub pilot bearing lightener core.

[c11] 11. A method of making a crankshaft for an engine, comprising:

- coating sand with a resin;
- blowing sand into each of a plurality of core boxes that each form an axial segment of the crankshaft that is radially split from adjacent core boxes of a core box assembly;
- setting the resin coated sand in the core boxes;
- assembling the plurality of core boxes with oil gallery cores to form a core box assembly;
- securing the core box assembly together with elongated fasteners that extend longitudinally through the core box assembly;
- placing the core box assembly into a cope/drag mold; and
- pouring molten ductile iron into the cope/drag mold and into the core box assembly to cast the crankshaft.

- [c12] 12. The method of claim 11 wherein the resin is a urethane resin and wherein the step of setting the resin further comprises injecting a catalyst gas into the core box to set off the resin.
- [c13] 13. The method of claim 12 wherein the catalyst gas is vented through a vent screed.
- [c14] 14. The method of claim 11 wherein the oil gallery cores have body portions and anchoring portions, wherein the body portions extend through an opening in the core box assembly and the anchoring portions are secured to the resin coated sand in at least one core box.
- [c15] 15. The method of claim 14 wherein the oil gallery cores are high temperature resin bonded sand cores.
- [c16] 16. The method of claim 11 further comprising inserting tungsten steel inserts into the core box assembly and supporting the inserts with sand cores during the pouring step.
- [c17] 17. The method of claim 11 further comprising inserting lightening cores into the core box assembly prior to the pouring step.